CLAIMS

1. A haptic feedback interface device in communication with a host computer implementing a host application program, said interface device manipulated by a user, the interface device comprising:

a device housing that is physically contacted by said user;

a sensor device operative to detect said manipulation of said interface device by said user, said sensor device outputting sensor signals representative of said manipulation; and

a computer-controlled electroactive polymer actuator operative to output a force to said user caused by motion of said actuator, wherein said force provides a haptic sensation to said user.

2. A haptic feedback interface device as recited in claim 1, wherein said force is correlated with an event or interaction implemented by said host computer.

3. A haptic feedback interface device as recited in claim 1, wherein said force output by said electroactive polymer actuator is an inertial force that is caused by moving an inertial mass.

4. A haptic feedback interface device as recited in claim 1 further comprising a button, and wherein said electroactive polymer actuator moves said button to output said force to said user.

5. A haptic feedback interface device as recited in claim 4 wherein said button is moved in a degree of freedom of motion of said button.

6. A haptic feedback interface device as recited in claim 4 wherein said button is moved laterally, approximately perpendicular to a degree of freedom of motion of said button.

7. A haptic feedback interface device as recited in claim 1 wherein said force output by said electroactive polymer actuator is a rotary force.

8. A haptic feedback interface device as recited in claim 1 wherein said force output by said electroactive polymer is a linear force.

9. A haptic feedback interface device as recited in claim 1 wherein said electroactive polymer moves portions of said device housing of said haptic feedback interface device.

10. A haptic feedback interface device as recited in claim 1 wherein said electroactive polymer moves a brake shoe against a moving part of said interface device to cause a resistance to said moving part.

11. A haptic feedback interface device as recited in claim 1 wherein said electroactive polymer provides tactile sensations when the user contacts a rotating wheel on said interface device.

12. A haptic feedback interface device as recited in claim 8 wherein said electroactive polymer actuator moves a member directly into contact or in shear with skin of said user to provide a tactile sensation to said user.

13. A haptic feedback interface device as recited in claim 12 wherein said electroactive polymer actuator is one of a plurality of electroactive polymer actuators of said interface device arrange in a tactile array.

14. A haptic feedback interface device as recited in claim 1 wherein said interface device includes a stylus.

15. A haptic feedback interface device as recited in claim 1 wherein said interface device includes a trackpoint joystick controller.

16. A haptic feedback interface device in communication with a host computer implementing a host application program, said interface device manipulated by a user, the interface device comprising:

a sensor device operative to detect said manipulation of said interface device by said user, said sensor device outputting sensor signals representative of said manipulation; and

an electroactive polymer actuator operative to output a force to said user caused by motion of said actuator, said actuator controlled by an input electrical signal, wherein said force provides a haptic sensation to said user.

17. A haptic feedback interface device as recited in claim 16 wherein said force output by said electroactive polymer actuator is an inertial force that is caused by moving an inertial mass.

18. A haptic feedback interface device as recited in claim 16 further comprising a button, and wherein said electroactive polymer actuator moves said button to output said force to said user.

19. A haptic feedback interface device as recited in claim 16 wherein said force output by said electroactive polymer actuator is a rotary force.

20. A haptic feedback interface device as recited in claim 16 wherein said force output by said electroactive polymer is a linear force.

21. A haptic feedback interface device as recited in claim 16 wherein said electroactive polymer actuator bends based on at least two layers of electroactive polymer material included in said actuator.

22. A haptic feedback interface device as recited in claim 16 wherein said electroactive polymer actuator includes a dielectric surrounded by two electrodes, wherein said dielectric expands in area when controlled with electrical signals.

23. A haptic feedback interface device as recited in claim 16 wherein said electroactive polymer moves portions of said device housing of said haptic feedback interface device.

24. A haptic feedback interface device as recited in claim 16 wherein said electroactive polymer moves a braking member against a moving part of said interface device to cause a resistance force to said moving part.

25. A haptic feedback interface device as recited in claim 16 wherein said electroactive polymer actuator moves a member directly into contact or in shear with skin of said user to provide a tactile sensation to said user.

26. A haptic feedback interface device in communication with a host computer implementing a host application program, said interface device manipulated by a user, the interface device comprising:

a device housing that is physically contacted by said user; and

an electroactive polymer (EAP) element, said EAP element operative to detect a manipulation of a manipulandum of said interface device and to output sensor signals representative of said manipulation, said EAP element also operative to output a force to said user in response to an input signal, said force caused by motion of said EAP element and providing a haptic sensation to said user.

27. A haptic feedback interface device as recited in claim 26 wherein said EAP element is operative to detect contact of said user with said manipulandum.

28. A haptic feedback interface device as recited in claim 26 wherein said EAP element is operative to detect an amount of pressure on said EAP element caused by said user.

29. A haptic feedback interface device as recited in claim 26 wherein said force output by said electroactive polymer is a linear force.

30. A haptic feedback interface device as recited in claim 26 wherein said interface device includes a joystick or trackpoint controller.

31. An method for outputting haptic sensations to a user of an interface device, the interface device manipulated by a user and coupled to a host microprocessor implementing a host application program, the method comprising:

detecting said manipulation of said interface device by said user and outputting sensor signals representative of said manipulation; and

outputting a force to said user using an electroactive polymer actuator by sending signals to said electroactive polymer actuator, where said force is caused by motion of said actuator, said force providing a haptic sensation to said user.

32. A method as recited in claim 31 wherein said electroactive polymer actuator outputs a rotary force.

33. A method as recited in claim 31 wherein said electroactive polymer actuator outputs a linear force.

34. A method as recited in claim 31 wherein said electroactive polymer actuator moves a braking member against a moving part of said interface device to cause a resistance force to said moving part.

35. A method as recited in claim 31 wherein said electroactive polymer moves portions of a device housing of said haptic feedback interface device to provide said force to said user.